The Beaver Lake Monitor

A publication of the Beaver Lake Management District Advisory Board

http://www.ci.sammamish.wa.us/BLMD.aspx#Home • Volume 11, Issue 2 • December 2010

Part three of the series: Living with your next door wildlife neighbors - Beavers

The North American beaver, *Castor canadensis*, is a highly skilled, amphibious, industrious, engineering mammal. Their fur is so warm and luxurious that they nearly were trapped to extinction about a century ago. But they managed to survive and now thrive to the point where they are sometimes considered pests. Beavers chew down trees that people plant, build dams that flood roads and fields, and cause consternation each year during salmon spawning season. Some people think beavers are cute and beguiling, whereas others would just as soon take a stick of dynamite to the nearest beaver lodge. But two things about beavers cannot be disputed: they are an integral part of Western Washington's landscape, and they are smart, tenacious little builders. In this article we'll explore some facts about beavers along with ideas on how to co-exist with these busy animals.

Beaver benefits

Beavers are major contributors to the landscape of Western Washington. Their dams form wetlands that improve water quality in stream systems and moderate water flow during storm events. The sediment trapped in the ponds forms a rich base for aquatic plants, which provide food and cover for a wide variety of birds, including bitterns and rails, red-winged blackbirds, marsh wrens, common yellowthroats, and many more. Plant stalks provide surfaces for amphibians such as red-legged frogs, Pacific treefrogs, and Northwestern salamanders to lay eggs, and these and other amphibians depend on wetlands in other stages of their life histories. Beaver ponds also provide rearing habitat for coho salmon and other small animals, which attract bigger animals like river otters.

How trouble starts

Beavers do many good things for the natural environment, but problems can arise because humans live in and commute through areas where beavers have an impact. Let's look at the combination of beaver ponds and roads as an example.

First let's start with a young beaver, a 2-year old male who has just left his natal pond, and he's looking for a place to call his own. He survives his dispersal trip to find a place along a low-gradient stream outside the territory of any other beavers. There are plenty of trees and vegetation for food: it's a perfect place to set up shop. As a highly social animal, he'll soon find a mate and start his own colony. For survival, the beaver family will need to be safe from predators as they move about, so (1) he'll build a dam to back up water, (2) he'll build a lodge in the pond with a submerged entrance, and (3) he'll keep the water levels deep enough so he can move between his lodge and his food sources. In this way, the water of the pond provides his cover. He will cut trees in the autumn and store them in chunks under water – that way, if the pond freezes over in the winter, he's got a supply of food safely tucked away.

The sound of rushing water appears to ignite beavers' instincts to build dams. Along the stream, the newly arrived beaver sets to work stopping the flow of the creek and creating his pond. If the sound of rushing water tells the beaver his source of protective cover is escaping, his survival instinct is to build more to stop leaks.

Enter the road. What if the dispersing beaver comes upon a culvert where a creek passes beneath a roadway? No one knows what a beaver thinks, but it might be something like, "Eureka! A dam has been built for me already except for this one round hole. All I need to do is patch it, and …Voila!" He sets to work to stop the flow by plugging the culvert, and pretty soon he's got a nice deep pool upstream. The stream continues to flow from the headwaters but no longer has a clear passage beneath the road, and the pond eventually starts to flow over the road. Now we've got a public safety issue.

Not every beaver problem is a public safety issue though. Another kind of trouble starts when a beaver decides

Story continued on Page 3

Lake Stewardship and Beaver Lake

By Raymond J. Petit
October 15, 2010

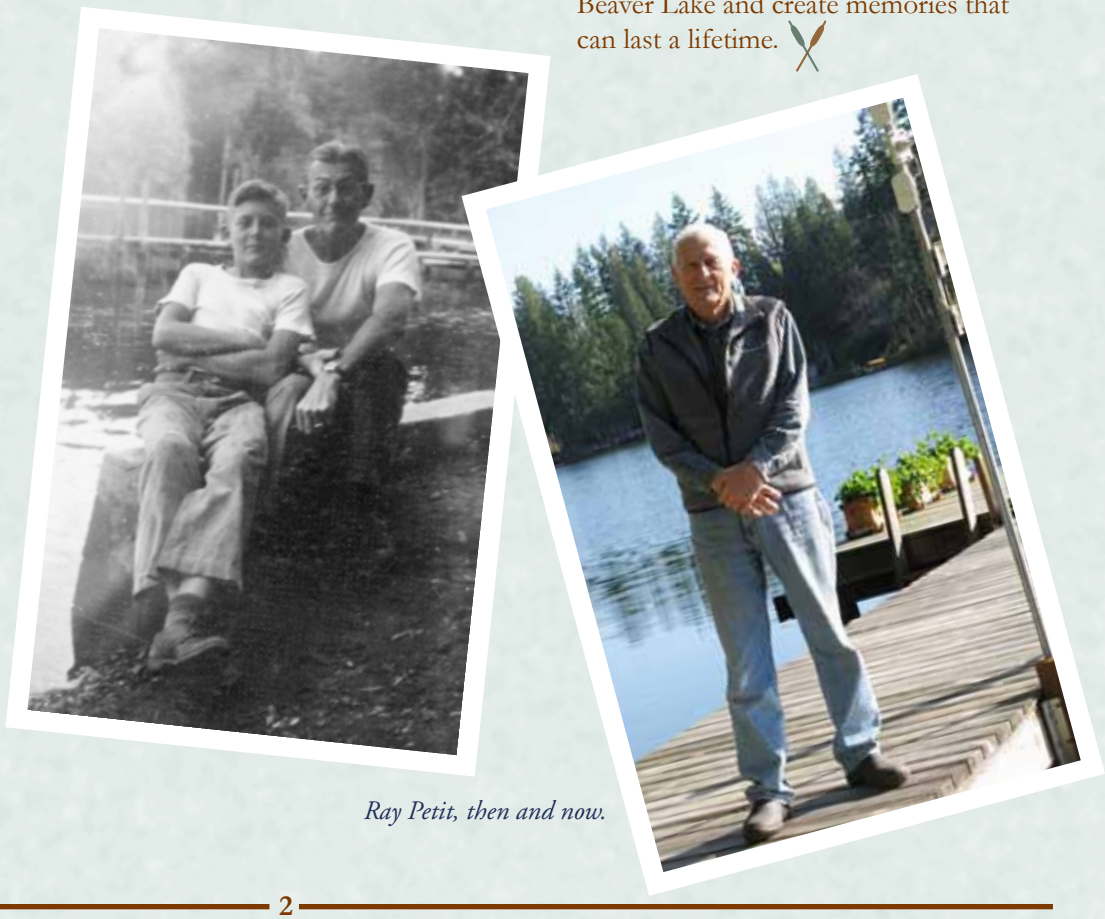
The Lake Stewardship Program for Beaver Lake was established to monitor the water quality of the lake in order to assess the real and potential changes that can occur over time. The use of volunteer monitors was started in the early 1980s and is a continuing activity. The monitoring process is in use for many small lakes in King County and individuals participating in the program take on the role stewards of their lake and watershed. Besides providing data for water quality analysis, the data is used for educational purposes, reports, recommendations and management plans.

When I became a resident of the Beaver Lake watershed I discovered the importance of Lake Stewardship and I have been involved in stewardship activities for most of the time I have lived in the area. The idea of Lake Stewardship may have started for me, without really knowing it, about 70 years ago when I was six years old and my dad and mother started vacationing at Beaver Lake. They would pack up everything needed to last for two weeks and we would head out to Beaver Lake. It was during the Second World War and we didn't have a car. A relative would drop us off at the lake resort and return in two weeks to pick us up. At the resort we always had cabin number 10 and lucky row boat number 21. Everyday was an adventure of fishing, swimming and family. My brother and I still talk about the fun we had and how really special this time in our life was for us.

Now, many years later, I have a home at Beaver Lake and my own family enjoys the surroundings of this beautiful area. The difference between my early memories of Beaver Lake and the present is that the watershed area was being heavily developed. In an effort to provide help for the protection of Beaver Lake I volunteered to be part of the Lake Stewardship Program and the lake monitoring process. I became a backup monitor and in 2001 took on the responsibility of Lake Monitor for Beaver Lake 2. This involved daily recording of the Lake Level and Precipitation, and once a week recording of the Secchi Depth, Lake Water Temperature, Weather Conditions and Algae/Particle Count. This year will mark my tenth year participating in this program. I have also been involved with the Beaver Lake Management District as a Board Member. All together, I have been a part of Lake Stewardship activities (in one way or another) for about the last 15 years. For me it has been enjoyable and personally rewarding.

I believe it is important to participate in activities that can offer a level of protection for the watershed and Beaver Lake. The establishment of the Beaver Lake Management District by property owners within the watershed is an example of Stewardship at its finest.

Stewardship activities can be very important in many areas of our lives and Lake Stewardship is just one of them. My dad enjoyed fishing and he really enjoyed Beaver Lake and what the lake had to offer. He was a great one for meaningful sayings and I remember him telling me more then once that "if you want nice things, take care of what you have". I easily recognized that my dad's saying could be applied to Beaver Lake and the functions of Lake Stewardship. The question "why we should care" may be answered by providing a young child the opportunity to come to Beaver Lake and create memories that can last a lifetime.



Ray Petit, then and now.

Living with your next door wildlife neighbors - Beavers

Continued from Page 1

that your little patch of peacefully growing trees is the next delicacy on his menu. Draping the trunks with chicken wire may save trees from destruction, but it doesn't contribute much to your garden's aesthetic.

Both with flooding and other problems, people are often tempted to rip out beaver dams in the hope that the offending animal will relocate. But when it comes to *Castor canadensis*, nothing is ever that simple. Remember that part about their instinct to make rushing water sounds go away? Beavers are building machines, and for them that pond is a life or death matter, so you can rest assured that if you try to take out the dam, not only might you send a lot of silt down the creek that impacts water quality and any salmon eggs that might be in the gravel, but the beaver will quickly set to work and very likely repair your damage by the next morning.

To carry out nearly all in-stream work in Washington, you must get a permit from the Washington Department of Fish and Wildlife. Anyone wishing to conduct an activity that will use, divert, obstruct, or change the bed or flow of state waters must obtain a permit (called the Hydraulic Project Approval, or HPA). WDFW has a Web page describing HPAs (http://wdfw.wa.gov/licensing/hpa/), which are required under the "Hydraulic Code" (Chapter 77.55 RCW; http://apps.leg.wa.gov/RCW/default.aspx?cite=77.55) passed in 1949. Beavers don't need the same permits, so they have an advantage over people in their response times.

You may consider hiring a trapper to remove the beaver. But ask yourself: will another beaver just move in and take its place? Beavers live 10-12 years, but the longevity of a particular pond in terms of beaver activity varies considerably. In other words, the beavers will stay as long as they can continue to forage. What that means is that if one beaver currently finds your yard a good place to eat, so will another beaver, which may move in very quickly if the current beaver is trapped out.

If your problem is flooding or high lake levels, there are many engineering solutions available. For example, you may install a water level-control device at the dam site, which allows the beaver to stay on location while water continues to flow downstream. If your problem is losing your trees and shrubs, there are a few approaches you might take so that you, your vegetation, and the local beavers may all co-exist.

Tree trouble, tree solutions

Various studies have been conducted to try to determine what beavers prefer to eat. During winter, beavers eat woody plants, and in the summer they eat mostly herbaceous materials.

- Preferred trees/shrubs include willow species, cottonwood, alder, vine maple, and aspen. They seem to avoid cascara, especially the young sprouts, and twinberry. If you want to plant native vegetation and beavers are living nearby, consider planting willows – lots and lots of willows. Willows are multi-stemmed shrubs that regrow quickly, so they are well adapted to being chewed on and will soon grow back in response.
- One way to protect your plants is by decreasing their palatability. An exterior latex paint colored to match the bark of the tree and applied around the base is one method used by several people. You might mix a little sand into the paint as well to further decrease palatability.
- Another option for decreasing palatability is to apply an herbivore repellant such as Plantskydd. It has proven effective in the Northwest, but it must be applied several times a year, particularly during our wet winters, when it is most likely to wash off.
- A mechanical barrier, such as a fence, placed between your newly planted vegetation and the beavers can be remarkably effective. Apparently beavers won't go around some fences. But be careful: if this is an area with heavy flooding, it is possible the beavers can go over the fence if the water level rises high enough.

Time for the mid-course evaluation

Water Year 2011 (October 2010 through September 2011) marks the 5th year of the current Beaver Lake Management District, which means it's time for the mid-course water quality evaluation for Beaver Lake. Monthly sampling events will occur in the lake for both the north and main basins, in addition to the yearly sampling of the two major inlet streams. In addition to water quality measurements, the algae and zooplankton populations will be examined, and a phosphorus prediction model will be fine-tuned for current conditions in the lake. The data will go towards an evaluation of the current Lake management Plan to see if it needs to be updated. Watch for King County's red canoe on the lake to see us in action!

WATER QUALITY UPDATE 2010

Beaver Lake Water Quality Monitoring Program

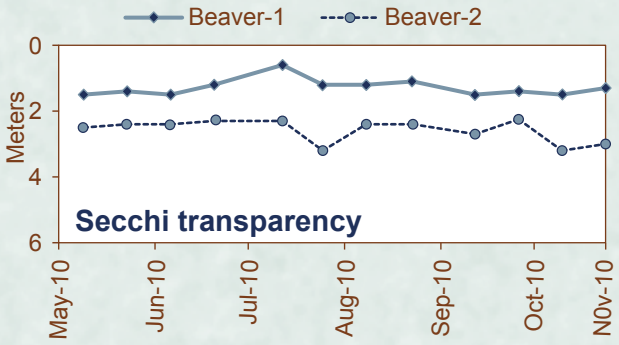
The Beaver Lake Management District (BLMD) contracts with the King County Lakes Program to track water quality late fall through spring in the two creeks that enter Beaver Lake. In addition, from May through October when the inlets are dry, King County works with volunteers to lake water quality measurements through the recreational season..

Results

Although "water quality" refers to various attributes, in summer several parameters are particularly interesting: Secchi transparency, phosphorus, nitrogen, and chlorophyll. Changes in these are often associated with increased development and may foreshadow nuisance algae blooms or other problems.

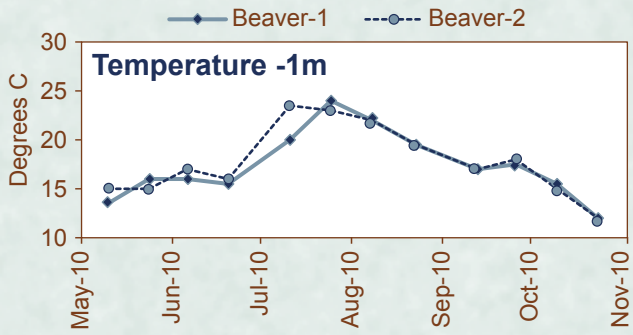
In this article, we will refer to the north basin as Little Beaver or Beaver-1 and the south basin as Big beaver or Beaver-2, similar to past articles.

Secchi transparency measures water clarity. While winter water clarity correlates with storm events bringing silt into the lake, summer clarity is mostly associated with algae populations and water color. Changes in water clarity often indicate something of interest happening in the lake.



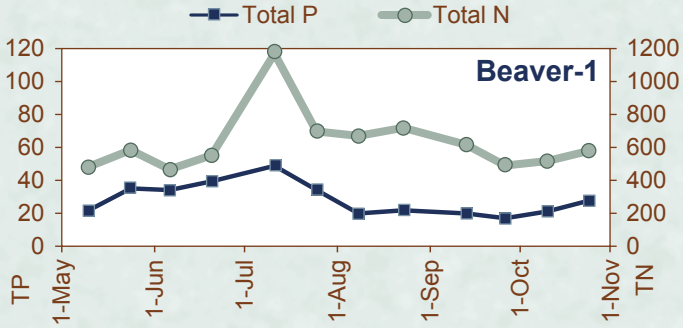
In Beaver-1, water clarity remained steady through the season, consistently less clear than Beaver-2. The lesser clarity in Beaver-1 can be explained partly by the natural tea color of the water, due to the nearby high quality wetland. Beaver-2 has less natural color in the water and so is generally more transparent than Beaver-1. Beaver-1 also has a greater natural algal productivity that reduces water clarity in summer.

Water temperature at shallow depths increases due to sunlight, air temperature and mixing by wind. All lakes show seasonal patterns, but small lakes are especially sensitive to weather patterns due to smaller volumes of water. Lakes in the Puget lowlands often begin warming by April and cooling in September, concurrently with changes in day length. Small lakes may receive a great deal of water through ground flow rather than over land flow. Such lakes will often remain cool in deep water through the summer. Ground water flow is also called "springs" by local residents and causes those subsurface patches of cold water felt by swimmers.

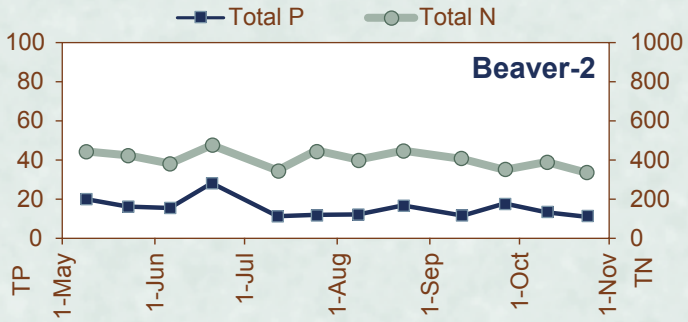


Shallow water temperatures in both basins followed the same pattern over the summer of 2010, with the cool, wet spring delaying temperature increase until hot weather in July warmed the surface water rapidly. The slower response of Beaver-1 may be due in part to the major role that groundwater plays in its thermal regime. After peak temperatures in July, the lakes cooled off slowly in tandem.

Phosphorus is a naturally occurring element that is necessary for life in small amounts. However, activities associated with residential and commercial development can increase lake concentrations, leading to more frequent and dense algae blooms – a nuisance to residents and lake users, and a potential safety threat if toxin-producing species dominate blooms. **Nitrogen** is also necessary and can sometimes limit algae growth, but is usually higher in concentration than phosphorus. The ratio between the two can determine which algal species have an advantage in the plankton. A sustained N:P ratio well below 20-25 signals a lake close to nitrogen limitation instead of phosphorus, which favors bluegreen algae that can use nitrogen from the air instead of relying on the dissolved form in the water.

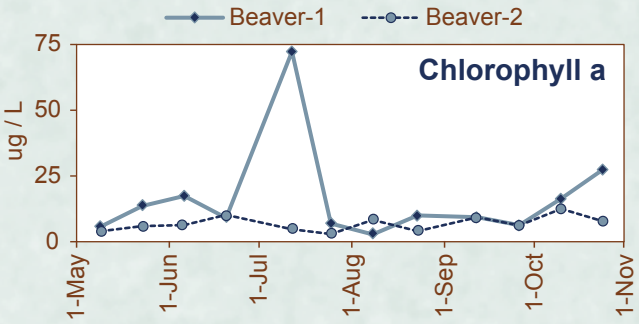


In Beaver-1, the ratio between total phosphorus and total nitrogen varied little through the season, but on one date in July, nitrogen increased dramatically relative to phosphorus. The minimum N:P ratio was 14, while the average over the season was 24. In general over the years of monitoring, both nutrients occur in higher concentrations in Beaver-1 than in Beaver-2, and 2010 appeared to follow the same pattern.



For Beaver-2, the ratio between total phosphorus and total nitrogen remained steady throughout the season, with little change over the period, unlike 2009 when the bluegreen *Anabaena* became abundant. The minimum N:P ratio was 17, while the average was 28, both higher than in Beaver-1.

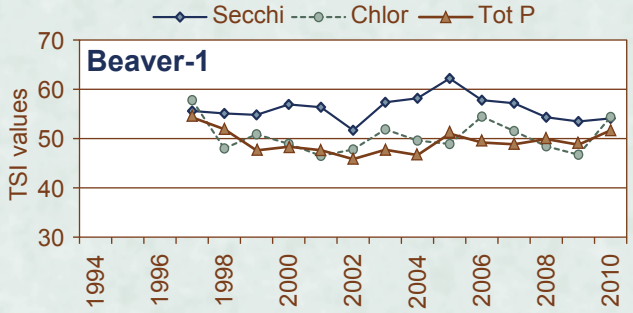
Chlorophyll is a measure of the abundance of the algae population present, as all algae must have some chlorophyll in order to carry out photosynthesis, the process that converts nutrients and sunlight into energy.



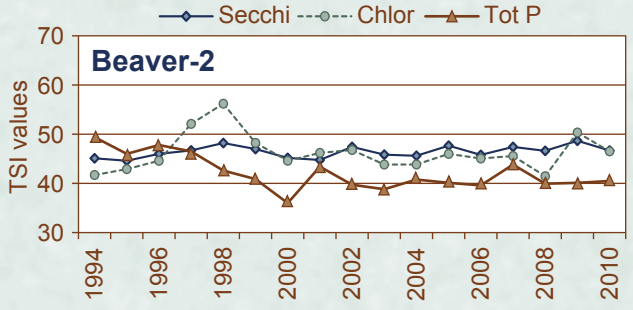
The chlorophyll measurements were often similar for the two basins in 2010, but Beaver-1 algae was somewhat higher in late spring, registered a large peak in July, and was climbing again through October, while Beaver-2 remained more or less steady throughout the season. In past years, chlorophyll has been consistently higher in Beaver-1 than in Beaver-2. One very high peak such as the one in Beaver-1 can be the result of sampling in a patch of algae, as some species may not be evenly distributed throughout the lake, depending on their mobility and water movements. The peak found in July was not sustained over the summer, supporting this interpretation. The noteworthy 2009 Anabaena bloom in Beaver-2 was not repeated in 2010.

Trophic state indicators (TSI) are values calculated from nutrient, Secchi transparency and chlorophyll measurements that relate to predicted algal productivity. TSI values allow for classification of a water body into 3 different levels of production, based on the results: high (eutrophic), medium (mesotrophic) and low (oligotrophic). The threshold between oligotrophic and mesotrophic is a value of 40, while the threshold between mesotrophic and eutrophic is 50.

While lakes can be in any of these classifications naturally, increases in watershed development and human activities can artificially move a lake from a lower classification to a higher one. This usually happens due to increases in the amounts of nutrients entering the lake, thus stimulating algae growth (which increases chlorophyll) that may also cloud the water, thus decreasing water clarity. Thus all three TSI indicators are changed. Tracking TSI values over time can produce a great deal of information about the direction of water quality in a lake.



TSI values have been calculated for Beaver-1 since 1997. Nutrients and chlorophyll have tracked each other closely each year and have varied from year to year without a validated trend over time, appearing relatively stable at the threshold between mesotrophic and eutrophic conditions. A possible upward trend since 2002 has poor statistical correlation. The Secchi TSI is significantly higher in all years but two, probably related to the naturally dark color of the water that impacts clarity aside from algae concentrations. Some large algae blooms have been recorded for this lake basin over the years, particularly made by the cyanobacterium *Aphanizomenon*. The high chlorophyll value in July 2010 is responsible for the increase in the chlorophyll TSI value from 2009.



Story continued on Page 6

WATER QUALITY UPDATE 2010

Continued from Page 5

TSI values have been calculated for the Beaver-2 lake basin since 1994. The years 1997-1999 had higher chlorophyll values than later years; however, the algae bloom in 2009 pushed the TSI value to the eutrophic threshold. In 2010 it dropped back to a level nearer to 1999 – 2008. In 2010, the TSI for phosphorus remained at the same level as in 2008 and 2009. In Beaver-2, the chlorophyll and phosphorus values do not seem to vary together as closely as they do in Beaver-1, but the TSI for Secchi is closely related to chlorophyll, showing that algae have a significant impact on water clarity. Currently, the lake is in the mesotrophic midrange, remaining stable. This suggests that controls on stormwater in the basin may be successful in preserving water quality in the main basin of the lake.

Summary

Water quality parameters in Beaver Lake have remained stable in recent years, and water quality is fairly good for both basins. Chlorophyll was very high in Beaver-1 on one date in July 2010, which could have been the result of sampling in a patch of algae. The data overall suggest that current city land use controls and practices have been effective in keeping development from degrading the lake and its beneficial uses.

Algae blooms may continue to occur, but should be fairly rare and limited over the long term. Observing the lake as development continues, particularly in the northern part of the watershed, will be key to understanding the long-term water quality prognosis for the lake.

Beaver Lake benefits from teen crew

Story on page 8

From Left to right: Stephan Kaczynski, Devan Carlson, Brad Kopanke and Ryan Galloway, juniors at Skyline High School and members of the "Alpental Ski Instructors."

Beaver Lake fecal coliform monitoring 2010

This year marked the sixth season of fecal bacteria monitoring in Beaver Lake by the King County Lake Stewardship Program (KCLSP) for the Beaver Lake Management District. This study was started because of lake users' interest in knowing if bacteria harmful to themselves or their pets might be in the lake water.

There are several standards in use for categorizing risk associated with human exposure to fecal coliform bacteria. The "Ten State Standard", used by King County's Swimming Beach Monitoring program, calls for closure of swimming beaches when the geometric mean of fecal coliform values is above 200 colony forming units per 100 milliliters (cfu/100mL), or if any single sample is above 1000cfu/100ml. However, this standard is for measured fecal coliform values rather than specifically for Eschereschia coli (E-coli), which is a good indicator of mammal and human fecal waste; there is currently no government standard for E-coli concentrations, even though evidence suggests that it is a more reliable indicator of health risk than total fecal coliform concentrations.

In the absence of a set standard, the KCLSP has chosen to use a threshold of 100cfu/100ml, based on a conservative interpretation of the Washington State water quality standards for fecal coliform. While values considerably higher than 100cfu/100ml may not pose a significant risk, repeated values over 100cfu/100ml likely are related to an ongoing source of fecal contamination. It is important to note that this threshold is a guideline used to gauge relative risk and potential point sources, so one-time values exceeding 100cfu/100ml should not trigger swimming restrictions or regulatory action of any kind.

E-coli can originate from several different sources, including pet and domestic animal waste, goose poop and leaking septic systems. Since E-coli move freely through water, results can also be quite variable over time and space. One station may produce a high E-coli count at one time, but measure below detection levels the next. It is important to sample stations repeatedly to look for over-all patterns. To measure E-coli in a cost effective manner, the Coliscan EasyGel method was used. This method has been shown to be a reliable test for E-coli and is approved by EPA in Region 4 (SE United States), although it is not yet officially approved in our EPA region (Region 10).

In 2010, sampling on Beaver Lake occurred once a month between June and September. All samples were taken from Big Beaver Lake because no levels of concern had been noted in Little Beaver Lake between 2005 and 2008. Stations in Big Beaver Lake were changed this year to ensure that the stations that have had higher levels of E-coli in years past were continued to be monitored and to add extra monitoring along the shoreline of older properties where potential E-coli contamination could be coming from leaky septic systems. Twenty sites were monitored throughout the lake in 2010 (Figure 1).

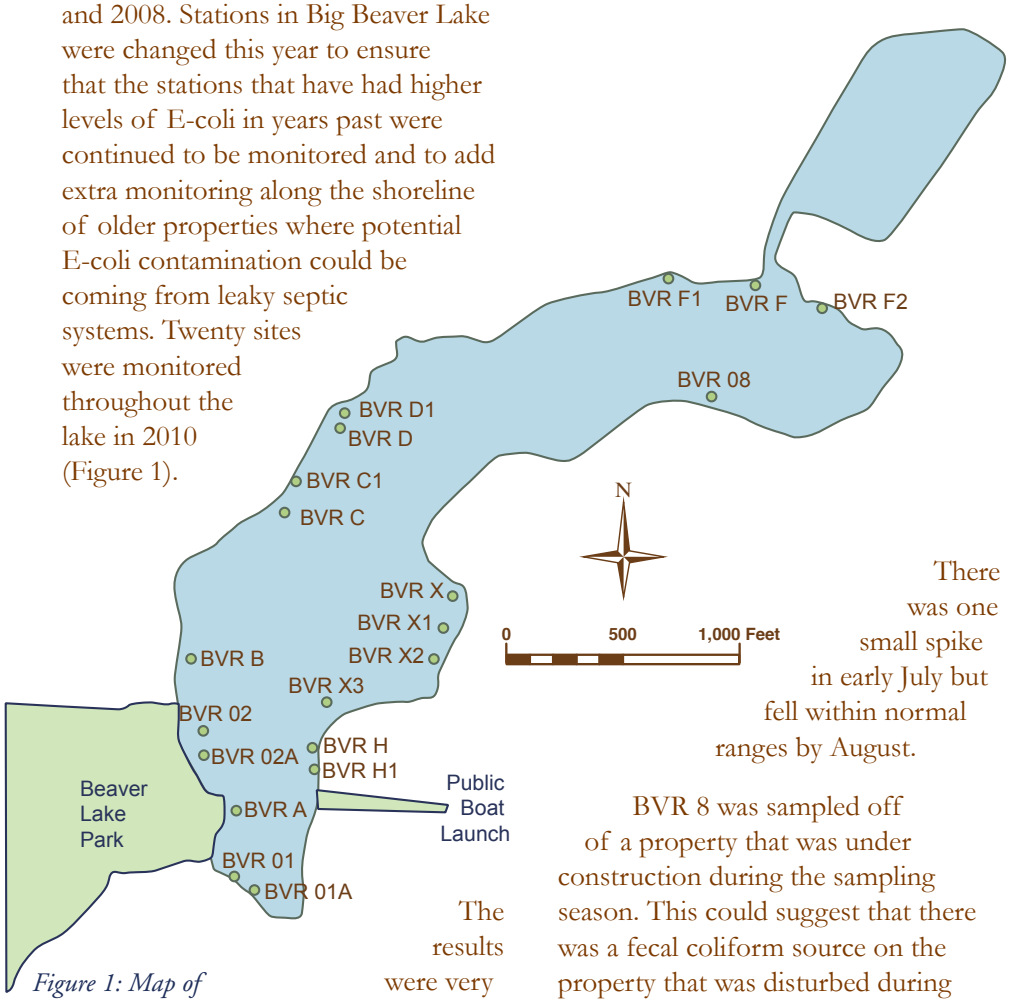


Figure 1: Map of Beaver Lake with 2010 station locators.

The results were very encouraging in broad terms. The monthly routine samples followed a very similar pattern as the previous five years. Only one station had samples with concentrations above 100 cfu/100mL and because of this, further sampling occurred around this station.

Station BVR 8 produced an abnormally high value of 920 cfu/100mL in early June. It was sampled once a week over the following two weeks and showed a drop within one week to 590 cfu/100mL and then to below detection levels by the end of June. There was one small spike in early July but fell within normal ranges by August.

BVR 8 was sampled off of a property that was under construction during the sampling season. This could suggest that there was a fecal coliform source on the property that was disturbed during construction. It is thought that the source was likely from an old septic drainfield. It is possible there could have been some septic leakage prior to the decommissioning of the septic tank causing contamination in surrounding soils and when those soils were disturb during construction the fecal coliform was able to enter the lake.

It is important to note that during the special sampling events, several locations in close proximity of BVR 8 were also sampled and none of those surrounding samples produced levels above 100 cfu/100mL. This suggests that the fecal coliform levels dissipated quickly once in the lake.

While one station produced E-coli levels of concern, the results were not replicated anywhere else in the lake and did not change water quality in the lake or endanger any recreation at the lake. These high levels are likely to be correlated to the construction on the property and serves as a reminder that Best Management Practices (i.e. silt screens) should be employed at construction sites along the shoreline to prevent soil and associated toxins from entering the water.

Overall, most of the routine sampling in 2010 produced average values well below the 100 cfu/100mL threshold. The highest average, aside from BVR 8, was found at Station BVR 2 (at the swimming beach) at 48 cfu/100 mL (Figure 2). Station BVR 2 has been one station that has been monitored for the last four years and while findings have generally been below the threshold, there have been a few instances of higher E-coli levels found. A potential source for the E-coli could be from the numerous dogs that swim off the beach.

The majority of the stations at Beaver Lake never had a sample that recorded 100 cfu/ 100 mL or higher. This suggests that from a fecal bacteria standpoint, Beaver Lake is safe for primary contact activities such as swimming (Figure 2).

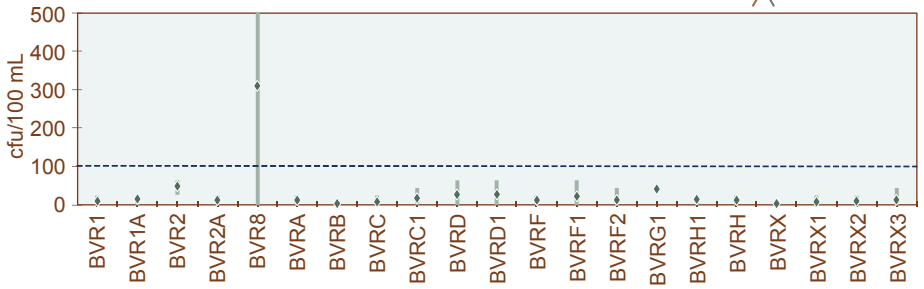


Figure 2: Beaver Lake Stations with maximum, minimum and average E-coli values for 2010.

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The Beaver Lake Monitor

December 2010

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Beaver Lake benefits from teen crew

By Stephan Kaczynski

The "Alpental Ski Instructors" in the photo have all been skiing since preschool and now are teaching young skiers on weekends. The boys have lived in the Beaver Lake watershed for most of their lives and are working to clean up around the lake for the King County Adopt-a-Road program, in addition to trail clearing and clean-up projects in the Beaver Lake Nature Preserve and the Hazel Wolf Wetland Preserve through the Cascade Land Conservancy.

The Adopt-A-Road Organization in King County inspires a sense of pride in the community. Through long hours of tedious cleaning of our major roads, we as a community have bettered our living space through the past few years that this organization has flourished. Twice a year, every six months, Ryan and Rory Galloway, Devan and John Carlson, Brad Kopanke, and Stephan and Walter Kaczynski (mostly around the ages of 16) take to the streets armed with trash bags and a will to clean. We travel in the early hours of the morning, digging through trenches and scouring the sidewalks for miscellaneous garbage to collect and dispose of properly. We began our involvement with this program when we noticed a lack of effort in the community as a whole to keep the Beaver Lake area clean for all to enjoy. Once we realized how much trash and random garbage were piling up in our trenches and roadsides, we decided that it was time to get involved. We contacted the Adopt-A-Road Organization, who put signs up all around the area advertising the service, and we quickly got to work, cleaning up the roadside and thus making a drive down West Beaver Lake a natural pleasure for all to enjoy. By pitching in less than a dozen hours a year, we hope to have helped the community to remember that we live in a unique area where the focus is upon preserving nature, and not on the quickest way to dispose of trash from the car.

The Beaver Lake Monitor
The Beaver Lake Monitor is published by the Beaver Lake Management District Advisory Board with the assistance of King County Water and Land Resources Division.

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